Maryland Historical Trust
Maryland Inventory of
Historic Properties Form

Inventory No. M:29-52-8

1. Name of Property (indicate preferred name)

historic: 36" Variable- Pressure Water Tunnel

other: Building 16

2. Location

street and number: Naval Surface Warfare Center Carderock Division, 9500 MacArthur Boulevard ___ not for publication

city, town: West Bethesda ___ vicinity

county: Montgomery

3. Owner of Property (give names and mailing addresses of all owners)

name: United States Navy

street and number: 9500 MacArthur Boulevard telephone

city, town: West Bethesda state: MD zip code: 20817-5700

4. Location of Legal Description

courthouse, registry of deeds, etc.: Montgomery County Courthouse liber: folio:

city, town: Rockville tax map: tax parcel: tax ID number:

5. Primary Location of Additional Data

___x___ Contributing Resource in National Register District
_____ Contributing Resource in Local Historic District
_____ Determined Eligible for the National Register/Maryland Register
_____ Determined Ineligible for the National Register/Maryland Register
_____ Recorded by HABS/HAER
_____ Historic Structure Report or Research Report at MHT
_____ Other: NSWC Carderock

6. Classification

Category
_____district
__x__building(s)
_____structure
_____site
__X__object

Ownership
__X__public
_____private
_____both

Current Function
_____agriculture
_____commerce/trade
__X__defense
_____domestic
_____education
_____funerary
_____government
_____health care
_____industry
_____landscape
_____recreation/culture
_____religion
_____social
_____transportation
_____work in progress
_____unknown
_____vacant/not in use
_____other:

Resource Count

Contributing	Noncontributing	
1	_____	buildings
_____	_____	sites
_____	_____	structures
1	_____	objects
2	_____	Total

Number of Contributing Resources previously listed in the Inventory
0

7. Description

Inventory No. M: 29-52-8

Condition

x excellent	___ deteriorated
___ good	___ ruins
___ fair	___ altered

Prepare both a one paragraph summary and a comprehensive description of the resource and its various elements as it exists today.

The 36" Variable Pressure Water Tunnel (VPWT), housed in Building 16, is situated at the southeast corner of Taylor Boulevard and Dolphin Road at the 183.6 acre Naval Surface Warfare Center, Carderock Division (NSWCCD). Located approximately 12 miles northwest of Washington, D.C., near Bethesda, Maryland, NSWCCD is situated north of the Potomac River and is bordered by the Clara Barton Parkway to the south and MacArthur Boulevard to the north and east. The installation today has over 100 buildings and structures that function as research laboratories, administration facilities, and operations and utility structures. At the center of the installation is the David Taylor Model Basin (Buildings 1-4) a group of interconnected buildings that include a model basin, administration building, a shop building and laboratory. The David Taylor Model Basin was listed on the NRHP in 1985. In 1996 the NSWCCD Historic District was determined eligible for the NRHP, and forty-four buildings and structures were recognized as contributing resources in the district.

The 36" Variable Pressure Water Tunnel

The VPWT is a closed circuit of more or less rectangular shape constructed of stainless steel and of other materials clad in stainless steel, with generally circular cross section. To achieve total air- and water-tightness, the tunnel sections are connected by bolted flanges, sealed with O-rings; the tunnel shell is welded.

The total height of the VPWT is approximately 118 feet, including the resorber which extends 78 feet below grade; total length is 68 feet. The VPWT has two interchangeable test sections that can be installed at the "top" of the tunnel loop: an open section for testing propellers and a closed section for testing forms, objects or equipment up to four feet long. A 78-inch adjustable four-blade propeller pump with variable-speed drive circulates water through the tunnel at varying rates, depending on the test, up to 1000 horsepower. The VPWT's two propeller dynamometer motor drive systems can rotate test propellers (up to 24") in either direction.

The VPWT is equipped with instrumentation for measuring, recording and controlling propeller torque, thrust and rpm; pump rpm; water speed; and test section water pressure. Other systems include those for tunnel water filtering and circulating system, refrigeration, deaeration, and purging air from the tunnel.

Building 16 has a structural steel frame clad with insulated precast concrete panels. The flat-roofed building encloses the tunnel, resorber and water storage tank in a section approximately 164 feet long, 28 feet wide, and 64 feet high. Steel flooring divides this section horizontally into two levels above the basement, providing access to all portions of the tunnel. The basement level contains the lower tunnel section. The first level provides access to the vertical sections of the tunnel. The main operating area (containing the upper tunnel and the test sections) is located at the second (top) level. The only windows in this portion of Building 16 are at the first and second levels on the east side; here, large, nearly square openings are fitted with multi-light steel industrial-type window elements.

On the west side of the tunnel enclosure are three flat-roofed building sections. The taller of the three is windowless and of three levels above the basement; in the top level is the control room from which the tunnel is operated and tests conducted. Beneath the control room is a fan and maintenance area. The first level contains toilets and locker room. In front of this section are two- and one-story office blocks, featuring horizontal openings variously fitted with glass block or late 20th century 8- and 12-light metal window units. At the south end of the one-story office block is a semi-subterranean block that is functionally part of the basement level, in which are the tunnel's motor-generator sets and switch gear.

The water tunnel, dynamometer systems, pumps, motors and switching gear remain today essentially as they were installed and placed in operation in 1962. The facility's original vacuum-tube electronic control system was within a few years updated to a solid state system; the facility now operates with PC-based localized control units installed around 2000. The office blocks on the west side of Building 16 represent a late 1960s expansion of what originally appears to have been a single one-story block.

8. Significance

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Period	Areas of Significance	Check and justify below		
__ 1600-1699	__ agriculture	__ economics	__ health/medicine	__ performing arts
__ 1700-1799	__ archeology	__ education	__ industry	__ philosophy
__ 1800-1899	__ architecture	__ engineering	__ invention	__ politics/government
X 1900-1999	__ art	__ entertainment/ recreation	__ landscape architecture	__ religion
__ 2000-	__ commerce		__ law	__ science
	__ communications	__ ethnic heritage	__ literature	__ social history
	__ community planning	__ exploration/ settlement	__ maritime history	__ transportation
	__ conservation		X military	__ other: ____

Specific dates 1955-62 **Architect/Builder** U. S. Navy, Bureau of Yards and Docks

Construction dates 1955-1962

Evaluation for:

_____X____ National Register _____Maryland Register _____not evaluated

Prepare a one-paragraph summary statement of significance addressing applicable criteria, followed by a narrative discussion of the history of the resource and its context. (For compliance projects, complete evaluation on a DOE Form – see manual.)

Summary

The 36" Variable-Pressure Water Tunnel at Naval Surface Warfare Center, Carderock Division, contributes to the significance of the NSWCCD Historic District. It meets National Register Criterion A for its direct and important association with the hydromechanics research, development, testing and evaluation programs established here with the opening of the David Taylor Model Basin in 1940 and expanded during the first two decades of the Cold War era (c. 1950-1970). The 36" VPWT also meets National Register Criterion C as an essentially unaltered facility designed for testing of propeller cavitation and related problems. The VPWT possesses integrity of design, workmanship, and materials, is in its original location, and maintains through its continued operation the integrity of its historical associations with the overall mission of NSWCCD. Building 16 of itself possesses no intrinsic significance beyond its having been erected to house the VPWT, its associated systems, and research staff in a building of rectilinear functional style typical of the period.

The 36" Variable Pressure Water Tunnel[1]

The 36" VPWT is the last, and largest of three similar facilities at NSWCCD. The David Taylor Model Basin was originally equipped with one, 12" water tunnel relocated from the Experimental Model Basin at the Washington Navy Yard in 1940. The following year, a 24" tunnel, initially planned and partly built at the Engineering Experiment Station at Annapolis, was moved to and completed at Carderock, thereby centralizing research into cavitation at this location. [2]

Within a few years after the DTMB became operational, it was evident that these two water tunnels, although primarily designed for propeller research, lacked certain capabilities, among them inability to measure propeller noise (due to the noise generated by the tunnels themselves) and inability to control the variability of the air dissolved in the water during tests, which caused problems with testing results. The tunnels' dimensions limited the size of propellers and other elements that could be tested, and each could test only one propeller at a time. Researchers at the DTMB therefore began initial plans for a third, 36" water tunnel in 1942. However, when it became evident that such a tunnel could not be built and made operational quickly enough to meet the Navy's immediate wartime needs, the plans were put aside.

After the war, planning resumed, and functional specifications for the 36" VPWT were completed in 1951. With multi-year funding from the Navy Public Works program, construction began in 1955 from engineering plan and specifications prepared by Seelye,

[1] The principal sources of information for this section are Brownell (1962), Anonymous (1964), drawings of the VPWT Building (Building 16) on file at the NSWCCD Public Works Department, and an interview with Dr. Stuart Jesup of NSCWWD's Hydromechanics Department on 04 October 2005.

[2] Both the 12" and 24" VPWTs are housed in Building 3 at NSWCCD.

Stevenson, Value and Knecht, Consulting Engineers with assistance from the Hydromechanics Laboratory and the Engineering Division of the Model Basin. Work proceeded slowly, but the new tunnel was ready for calibration in April 1962. A failure of the up-comer tube in the resorber pit required replacement of that element, but the facility was ready for use by December of that year.

With its interchangeable test sections, the 36" VPWT proved more versatile than its smaller counterparts, and the inclusion of a resorber in the design permitted far greater control of the air content of the water during tests. It was significantly quieter, thus enabling measurement of noise produced by the test objects, and could test contrarotating dual propellers up to 18" diameter as easily as a single propeller. With periodic upgrades of its computerized electronic control systems, the 36"VPWT has made possible much valuable research into and testing of propeller operation, as well as numerous studies of the cavitation characteristics of many other objects and forms.

Historic Context

The U. S. Navy's first laboratory for studying ship behavior was the United States Experimental Model Basin (EMB). Constructed in 1898 under the leadership of Rear Admiral David Watson Taylor, the EMB was located at the Washington Navy Yard. Designed for the testing of ship hulls, propeller studies, and rudder developments, the basin contained a carriage that towed wooden shop models and carried cameras to allow engineers to study how eddy and wave making resistance were generated (Melhuish 1996). In 1912, due to advancements in aviation, the Navy expanded its laboratory facilities to include a wind tunnel. Designed by aeronautical engineers, Holden C. Richardson and William W. McEntree, the Navy's first wind tunnel was completed in 1913 and was used to test the resistance of shapes in air to improve the aerodynamics of airfoils, body shapes, and windshield design (Carlisle 1998: 78).

The facilities at the Washington Navy Yard soon proved inadequate. The basin was resting on an unsteady foundation undermined by springs, and it had become technically insufficient to meet the demands of both commercial users and the rapidly modernizing Navy (Carlisle 1998: 132). In 1936 Congress authorized funding for the construction of a new basin, and in 1937, 107 acres in Carderock, Maryland was chosen for the new installation due to the presence of bedrock, level terrain, nearby water supply, and accessibility to downtown Washington (Carlisle 1998: 144). Construction at Carderock began in 1937, and the official dedication was held on November 4, 1939 for the David Taylor Model Basin, named in honor of David W. Taylor.

The primary mission of the DTMB, as defined by Congress, was to investigate and determine the most suitable and desirable shapes and forms for naval vessels and aircraft (Melhuish 1996). During its first year of operation, the DTMB was mostly involved in design work, but at the outset of World War II, activities at the DTMB were focused on war-related topics. Research became a major directive, and new facilities and staff were added to support research activities. New facilities added to installation included a research pit for explosion testing (1941), wind tunnels and associated buildings (1942), a pentagonal test pond to test under water explosives (1943), Circulating Water Channel to test the angles and drag of underwater towed devices (1944), and two supersonic wind tunnels that had been dismantled in Germany and installed at Carderock (1946) (Melhuish 1996).

The "Golden Age of Research" at Carderock (c. 1950-1970)

Expansion of the aerodynamics facilities at Carderock after World War II coincided with a "drastic realignment" of mission that inaugurated a "Golden Age of Research" for DTMB (McCarthy 1993: 30, 34). Over this period (1950-1970) DTMB was able to expand its hydrodynamics facilities to include elements planned but not built during the war, and to bring on board the new technology of electronic computing, which thereby added numerics to the formidable analytical and experimental capabilities already present. The Structural Mechanics department obtained a large new facility, and acoustics became an important new area of inquiry.

The Applied Mathematics Department was established in 1952, originally (1953) equipped with a Universal Automatic Computer (UNIVAC-A). The Livermore Atomic Computer (LARC) was added in 1960 (Melhuish 1996). The Applied Mathematics Department was actively involved in the Navy's nuclear research program, providing mathematical predictions of the core life of submarine nuclear reactors to accurately project refueling requirements. This department also provided important support to the Hydromechanics and Structural laboratories by developing "numerical solutions to...complex problems of computational fluid and structural mechanics" (Carlisle 1998: 224). By the late 1950s the computer laboratory was performing horsepower calculations, performing propeller studies, and predicting blast effects on ship hulls and effects of vibration on structures. In 1959, DTMB's mission was modified to include high speed computer services to the Bureau of Ships, its laboratories, and its shipyards (Melhuish 1996).

Within two short years after the model testing facilities at DTMB became fully operational (1940), scientists and engineers saw the need for additional facilities, specifically a water tunnel larger than the existing 12" and 24" tunnels (which did not provide sufficient capacity for propeller cavitation experiments) and a basin sufficiently large and well-equipped to conduct maneuvering tests, test in waves and tests requiring high water speed. Planning for both water tunnel and maneuvering basin was begun in 1942. However, when it became apparent that neither facility could be completed and activated fast enough to meet the urgent needs of wartime, these plans were suspended (Brownell 1962: 1). After the war, planning resumed, and with multi-year funding from the Navy Public Works program, construction began on a new 36" water tunnel in 1955, and on a maneuvering basin and a large rotating arm basin (under one roof and called the Maneuvering and Seakeeping (MASK) facility in 1956. The MASK facility was ready for calibration and use in 1961, the water tunnel the following year (Brownell 1962: 2-3).

1963 saw the establishment of another new department, the Acoustics and Vibration Laboratory, which brought together scientists and engineers from several other departments to play a lead Navy role in measurement and diagnosis of full-scale radiated noise signatures from ships and submarines – an area of inquiry of paramount importance to the Navy's submarine warfare programs (McCarthy 1993: 32). Four years later, the Structural Mechanics department obtained a major new facility featuring five high-pressure deep submergence tanks for testing the hulls of underwater vehicles and a test bed for stressing large model ship structures under loads up to 250,000 lb. (McCarthy 1993: 33). By 1970, the acoustics department had significantly expanded its capabilities with the addition of acoustic ranges off Washington and California, plus, at Carderock, completion of an Anechoic Data Analysis Center and an anechoic flow facility consisting of a subsonic wind tunnel equipped with an anechoic chamber (McCarthy 1993: 32-33) That same year the Systems Development Department was created "with the intention of providing a total ship systems, hardware-oriented focus" (McCarthy 1993: 36).

On 31 March 1967, the Marine Engineering Laboratory at Annapolis and the Carderock facilities were merged to form the David Taylor Naval Ship Research and Development Center. However, the "Golden Age" of research at DTMB came to an end in the 1970s, as funding declined and staff were reduced from 3122 to 2482 – totaling a loss of 640 by 1980 (McCarthy 1993: 33). When funding resumed under the Reagan administration, it was on a very different basis, as most of the Center's annual budget was contracted to private industry. The Center was increasingly involved in both design and hardware demonstration phases of vehicle development, and there was much less support for "fundamental research, exploratory development, and advanced development investigations" (McCarthy 1993: 37, 40).

Period of Significance for the NSWCCD Historic District

The 1996 survey of NSWCCD proposed a period of significance for the NSWCCD Historic District beginning in 1938 and ending in 1958. The MHT Historic Sites form for the district justifies the end date of 1958 with the statement that "this year [e.g. 1958] marks the end date for the construction of physical model testing and research facilities and marks the introduction of computer aided research, design, testing and evaluation program". Research conducted in 2005, in association with evaluation of the 36" VPWT

indicates that, to the contrary, two important model testing facilities originally planned during World War II (one of them being the 36" VPWT), were under construction in 1958 and would be completed within the next few years. Furthermore, although the Center's mission was "formally expanded [in 1958] to include computers and computer services in the development of naval vehicles" such capabilities had been employed at Carderock since installation of the UNIVAC-A at the Applied Mathematics Laboratory in 1953. The 1993 article "David Taylor Research Center" by Justin McCarthy, then head of the Naval Hydromechanics Division at Carderock, offers persuasive evidence that the introduction of computers did not eclipse the model testing programs, and that there was indeed a two-decade "Golden Age" of well-funded, innovative research fueled by the Navy's prosecution of the Cold War both in the laboratory and at sea. As a result, the period of significance for the NSWCCD may reasonably be extended to 1970; thereafter the Center experienced substantial funding and staffing cuts, followed by new emphasis on applications for private industry and significantly less support for "fundamental research and exploratory development".

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Name
Continuation Sheet

Number 9 Page 1

Anonymous
1964 Research Facilities at the David Taylor Model Basin. Department of the Navy, David Taylor Model Basin, Hydromechanics Laboratory Research and Development Report No. 1913.

Brownell, W.F.
1962 Two New Hydromechanics Research Facilities at the David Taylor Model Basin. Department of the Navy, David Taylor Model Basin, Hydromechanics Laboratory Research and Development Report No. 1690.

Carlisle, Rodney P.
1998 Where the Fleet Begins: A History of the David Taylor Research Center 1898-1998. Department of the Navy, Naval Historical Center, Washington DC.

Harper, Harry D.
1983 "A Modernized Control System for the David Taylor Ship Research and Development Center's 36" Variable Pressure Water Tunnel", paper presented at the Systems and Techniques Symposium of the 20th American Towing Tank Conference, Stevens Institut of Technology, Hoboken, New Jersey (August 1983).

McCarthy, Justin H.
1993 "David Taylor Research Center", in H. Benford and W.A. Fox, editors, A Half-Century of Marine Technology, 1943-1993. Society of North American Mechanical? Engineers, Jersey City, New Jersey.

Melhuish, Geoffrey E.
1996 *Historical and Architectural Documentation of the Naval Surface Warfare Center Carderock Division, Maryland: Draft.* Prepared by R. Christopher Goodwin and Associates, Inc. for Engineering Field Activity-Chesapeake, Washington, D.C.

US Department of the Navy
1955 "Thirty-six Inch Variable Pressure Water Tunnel Building, David W, Taylor Model Basin, Carderock, Maryland". Set of drawings generated by the Bureau of Yards and Docks District Public Works Office, Potomac River Naval Command, Washington, D.C. On file at Public Works Department, NSWCCD.

1967 "Building 16 – 36" Variable Pressure Water Tunnel, Additional Office Space for First and Second Floors." Drawing on file at Public Works Department, NSWCCD.

9. Major Bibliographical References

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See Continuation Sheet.

10. Geographical Data

Acreage of surveyed property	less than one		
Acreage of historical setting	186 acres		
Quadrangle name	Falls Church	Quadrangle scale:	1:24000

Verbal boundary description and justification

The boundary of the of resource coincides with the footprint of Building 16 at the Naval Surface Warfare Center, Carderock Division.

11. Form Prepared by

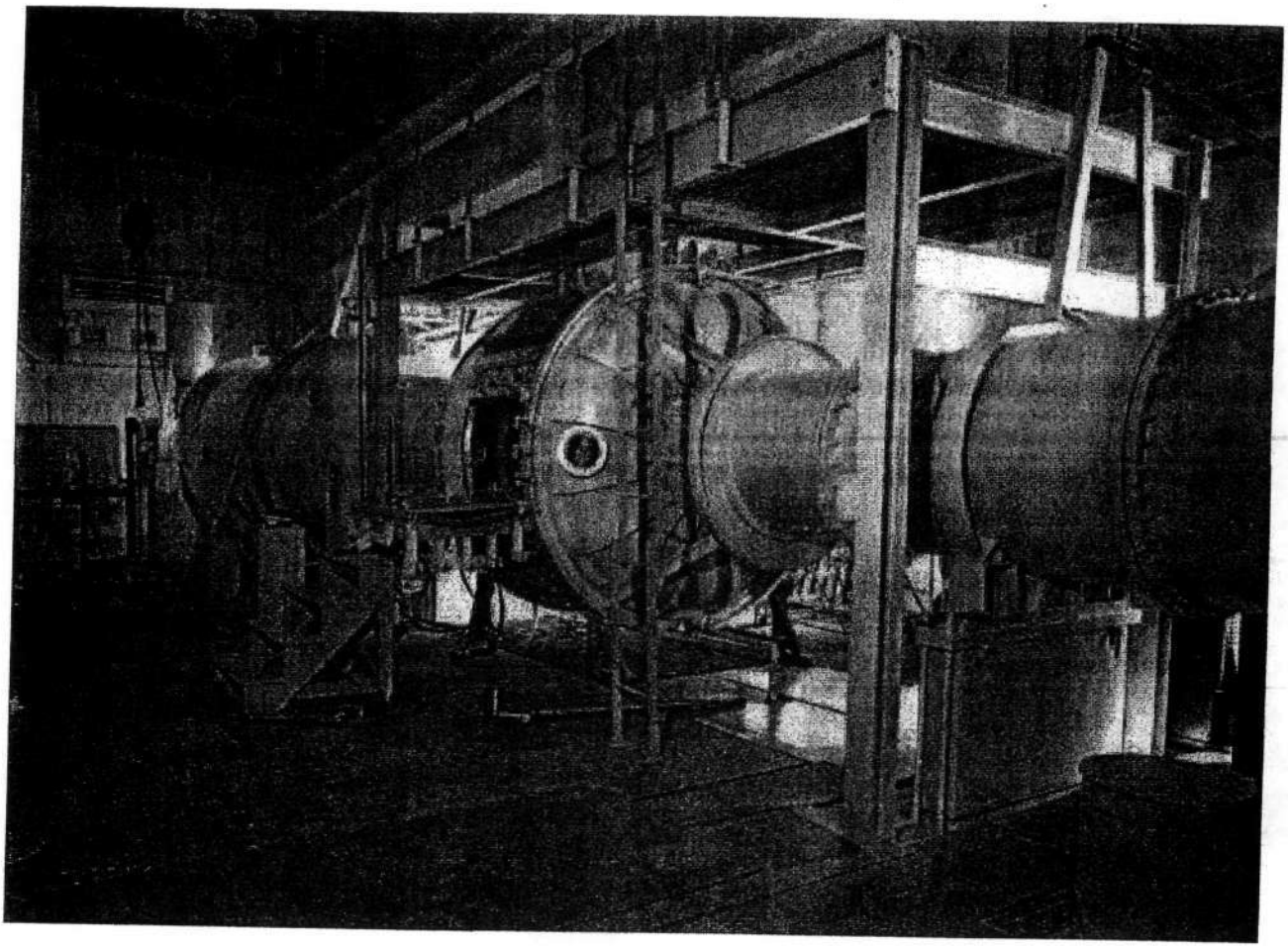
name/title	M.H. Bowers		
organization	The Louis Berger Group, Inc.	date	November 2005
street & number	75 Second Ave.	telephone	617 444 3330
city or town	Needham	state	Mass 02494

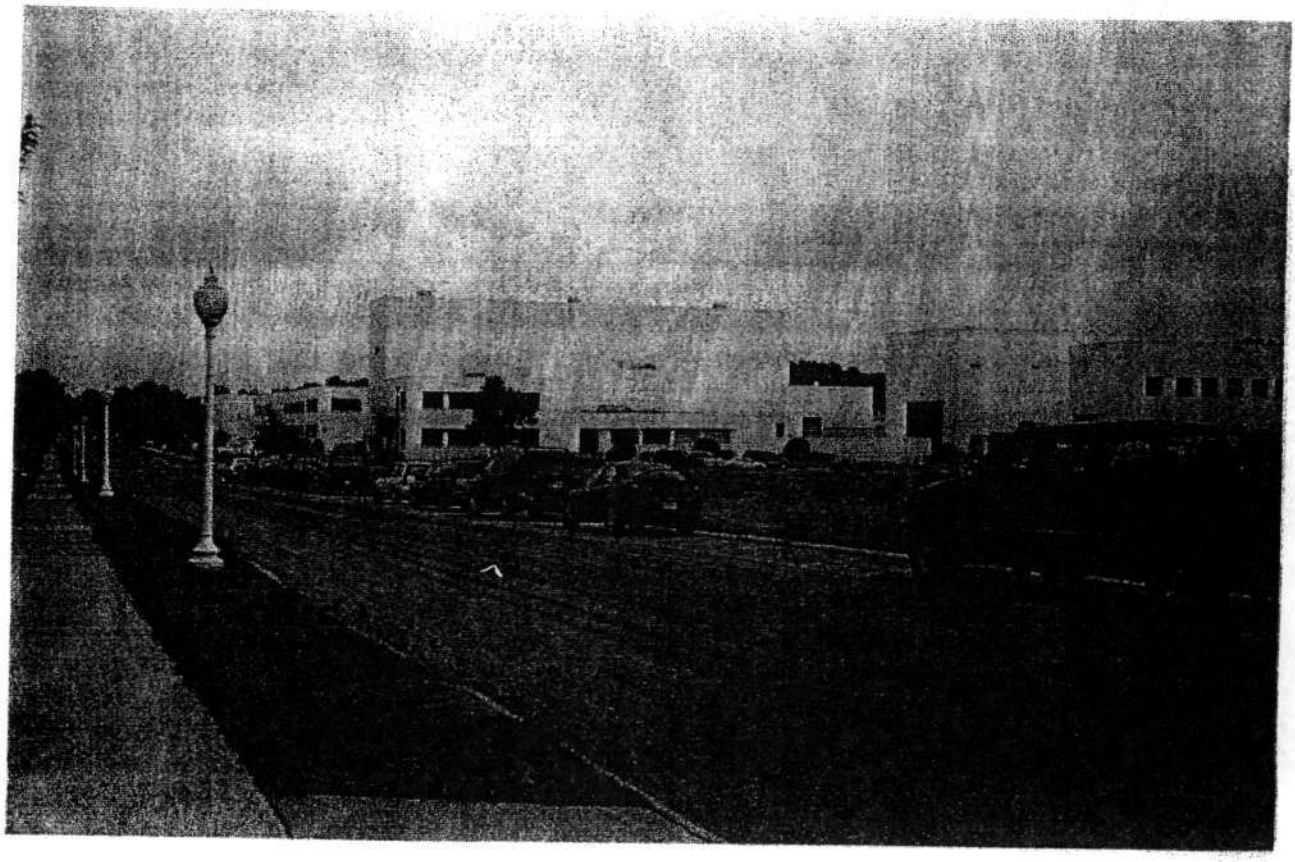
The Maryland Inventory of Historic Properties was officially created by an Act of the Maryland Legislature to be found in the Annotated Code of Maryland, Article 41, Section 181 KA, 1974 supplement.

The survey and inventory are being prepared for information and record purposes only and do not constitute any infringement of individual property rights.

return to: Maryland Historical Trust
DHCD/DHCP
100 Community Place
Crownsville, MD 21032-2023
410-514-7600

M: 29-52-8





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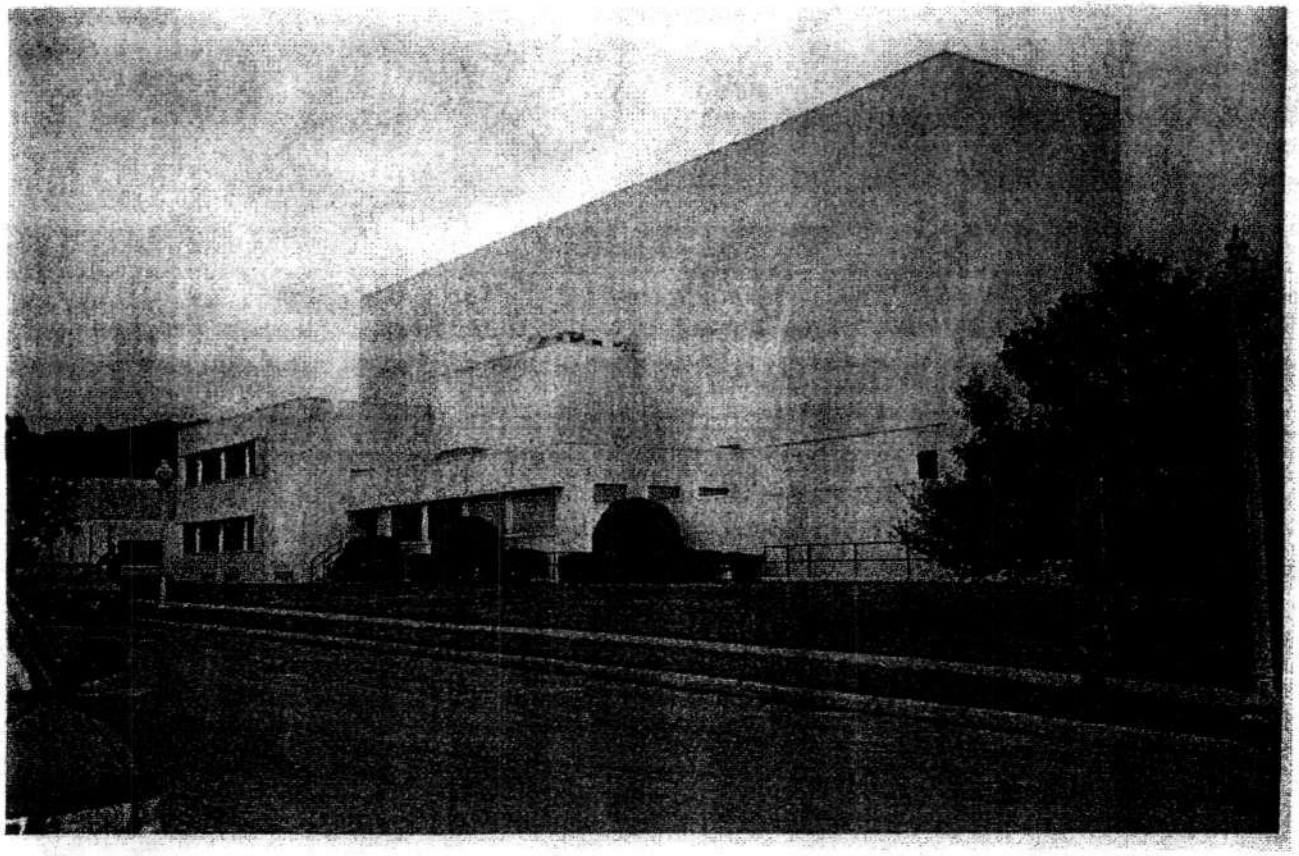

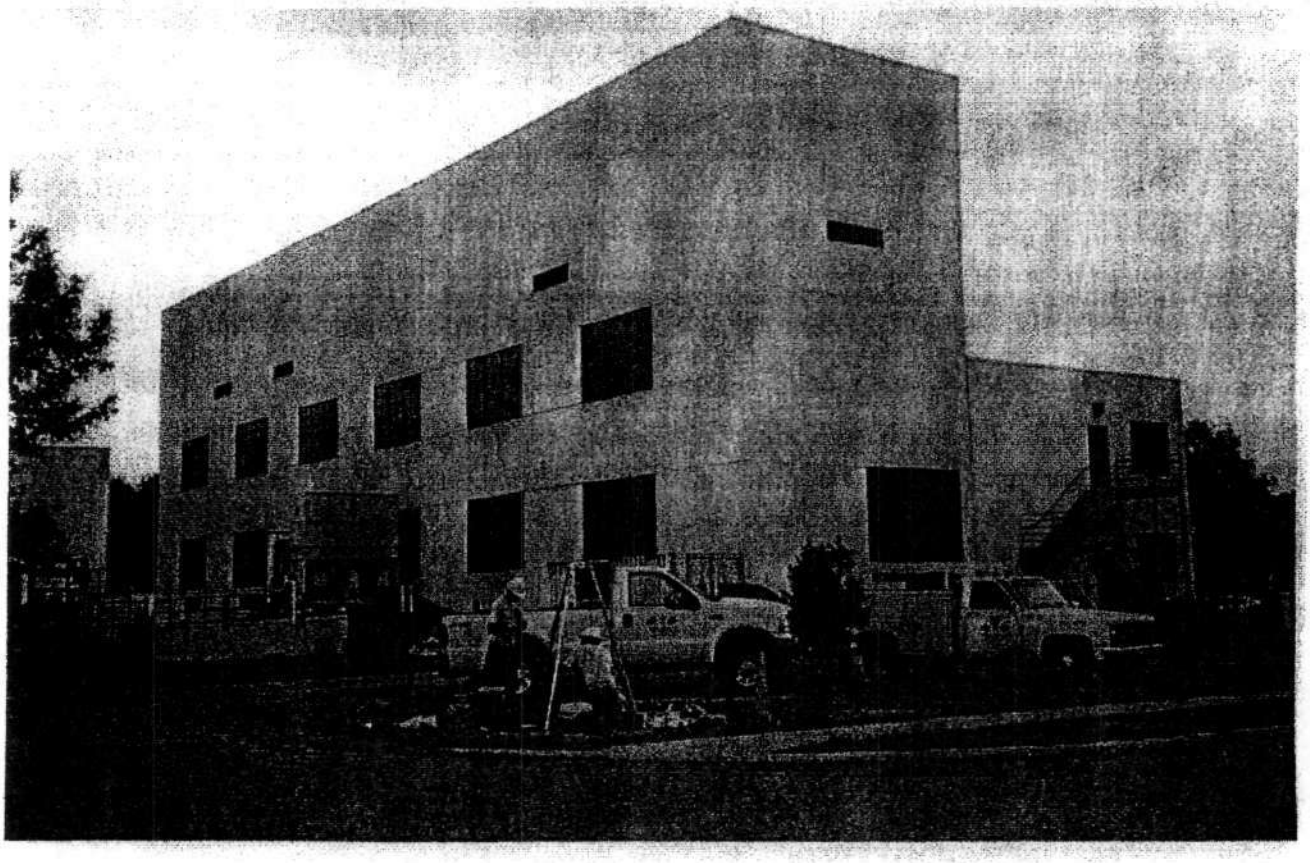

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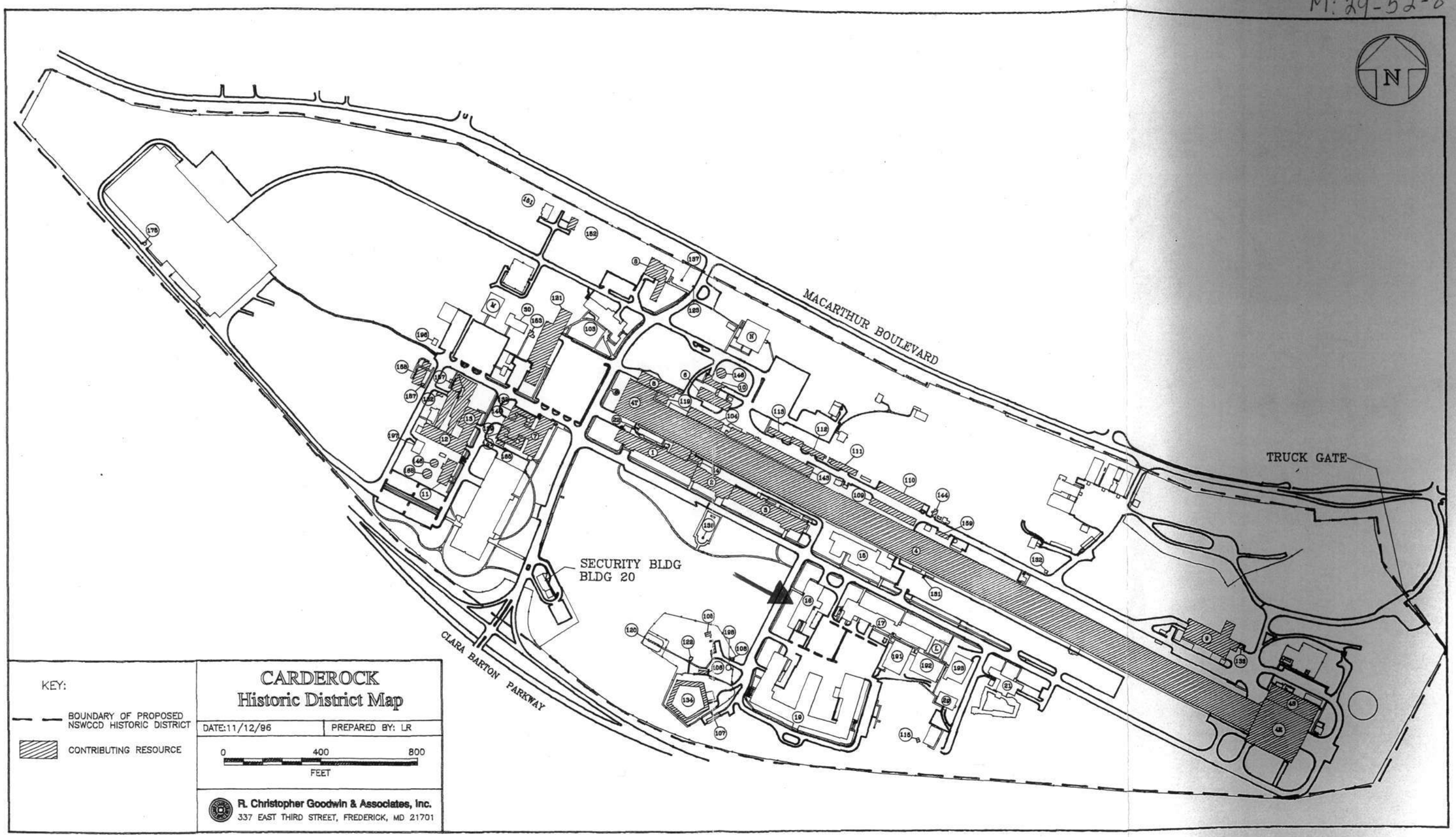
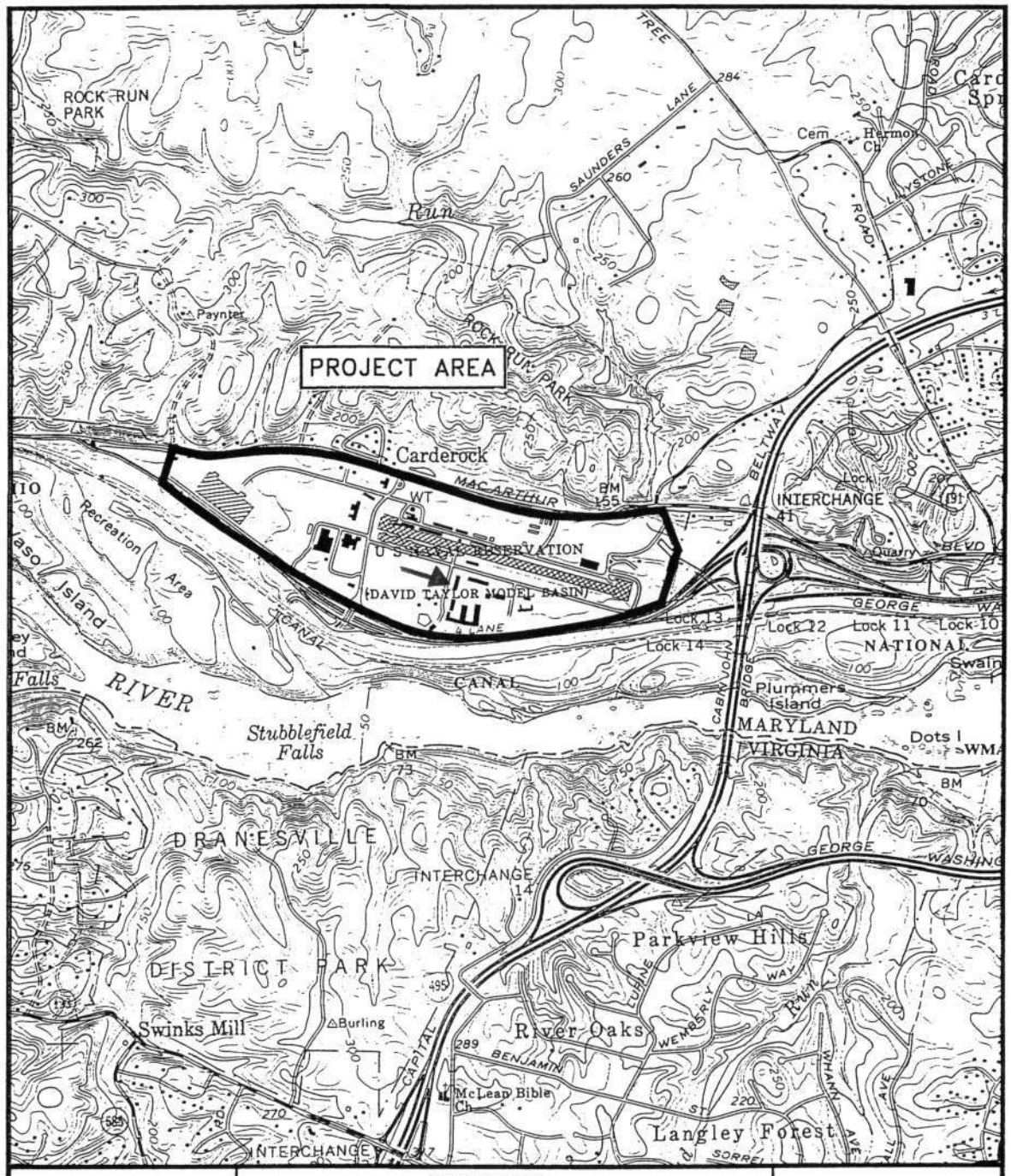


Figure 2. Map of NSWCCD Indicating Locations of Identified Historic Properties

M: 29-52-8



R. Christopher Goodwin & Associates, Inc.
337 EAST THIRD STREET, FREDERICK, MD 21701